

Gender differences in the contribution patterns of equity-crowdfunding investors

Ali Mohammadi · Kourosh Shafi

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Abstract This paper is an exploratory attempt to understand gender-related differences in the behavior of investors in firms seeking equity financing. Using data from the Swedish equity crowdfunding platform FundedByMe, we find that female investors are less likely to invest in the equity of firms that are younger and high tech and have a higher percentage of equity offerings. This pattern seems consistent with a greater risk aversion in female versus male investors. Furthermore, female investors are more likely to invest in projects in which the proportion of male investors is higher.

Keywords Equity crowdfunding · Gender · Herding · Observational learning · Risk aversion

JEL classifications G02 · G11 · G20 · M13

1 Introduction

With accelerating growth in the popularity of equity investments facilitated through equity crowdfunding

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A. Mohammadi (✉)
Department of Industrial Economics and Management, Royal
Institute of Technology (KTH), 100 44 Stockholm, Sweden
e-mail: ali.mohammadi@indek.kth.se

K. Shafi
Warrington College of Business, University of Florida,
Gainesville, USA

platforms, we ask whether there are gender differences in the pattern of equity investments. Investment behavior is likely to depend on investor gender (for recent reviews, see Croson and Gneezy 2009 and Bertrand 2011) evidenced by experimental studies, pension wealth asset allocation choices, or managerial firm-level investment decisions (Jianakoplos and Bernasek 1998; Barber and Odean 2001). To further such evidence, in an explorative study, we seek to shed light on gender-related differences of investment decision-making in the setting of equity crowdfunding.

First, we draw from an established body of literature arguing that gender-related differences of investment behavior are due to risk preferences and investigate whether female investors are more risk averse in equity crowdfunding. This is of great importance as equity crowdfunding features two distinct characteristics for investors. First, this setting characterizes decision-making under extreme risk relative to prior research settings (e.g., experimental studies, stock market, or pension funds). Second, the uncertainty associated with equity investing is compounded by limited investor expertise (Ahlers et al. 2015) in evaluating the adverse selection risks and moral hazard problems inherent in equity investments (Gompers and Lerner 2004). Overall, our first research question explores whether gender influences the extent to which investors choose risky projects in equity crowdfunding.

Second, by drawing from herding logic, we study the extent to which the gender of prior investors is salient information for herding when differentiating between male and female investors. Herding is cited to be a prominent feature of crowdfunding markets (Colombo et al. 2015; Vismara 2016a; Hornuf and Schwiendbacher 2015b), yet no empirical study has thus far attempted to investigate the possibility of gender differences in

herding. Therefore, our second research question explores whether the pattern of herding behavior across the gender of investors in equity crowdfunding is influenced by the gender of prior investors.

The setting of equity crowdfunding can provide additional insight into the study of gender differences in investment behavior. To the extent in which we expect that risk is a prominent feature of gender differences in investment behavior, our gender-based analysis is likely to be relevant in the context of equity crowdfunding. To invest in young firms, individuals face high risk and uncertainty regarding the value of a firm. A significant amount of information asymmetry exists between investors and firms. Young firms tend to have limited histories and track records for informed assessments by prospective investors and partners (Stuart et al. 1999). Entrepreneurs tend to be too optimistic or have a natural incentive to exaggerate their prospects and the potential value of their firm (Cooper et al. 1988; Busenitz and Barney 1997), which often is tied to growth expectations rather than tangible assets in place (Shane and Cable 2002). The erroneous valuation of entrepreneurial opportunities is a direct result of such information issues. Furthermore, all of these issues are likely to be exacerbated for small investors who represent the majority of investors in equity-crowdfunding platforms (compared with professional investors such as venture capitalists and business angels). These small investors have limited expertise, incentives, or available resources to perform any substantiated due diligence.

Additional interest on the issue of gender and equity crowdfunding comes from the premise that equity crowdfunding has the potential to democratize access to investment opportunities for female investors who are under-represented among traditional equity investors, e.g., business angels and venture capitalists. Overall, given the increasing growth and popularity of equity crowdfunding, it seems timely to shed light on the behavior of equity crowdfunding participants in general (e.g., Ahlers et al. 2015; Vismara 2016a) and the gender-induced component of this behavior in particular.

We present two sets of evidence regarding the gender-related behavior of investors. First, in line with prior studies claiming that female investors are more risk averse than male investors, we find that female investors are less likely to invest in high-technology firms, young firms, and firms with a higher percentage of equity offered in the platform.

Second, we are the first, to the best of our knowledge, to propose evidence regarding gender-related herding effects. One might assume that women are more likely to follow other women in their decisions to invest because of the risk aversion of female investors and the potential circulation of investment information in common social networks shared by other women. In contrast, we find that female investors are more likely to invest in firms with a higher proportion of male investors. There are several plausible explanations related to social psychology, including (a) the stereotypical view of women as incompetent investors and (b) the gender-induced bias of women in male-dominated fields to favor the decisions of men as the dominant group. We discuss these explanations in detail later. Moreover, we explore whether favorable firm characteristics moderate the observed patterns of herding so that we can infer rationality of herding behaviors. Drawing on the logic borrowed from Zhang and Liu (2012), we test whether certificates of firm quality, such as the receipt of prior seed investment, dampen the momentum of herding; if so, we conclude that herding is rational because subsequent investors infer that favorable characteristics drive momentum, as prior investors tend to incorporate this favorable information into their decisions (we clarify the details of our reasoning later). In our setting, women fail to observe that momentum behind men's decisions for investment is related to favorable project characteristics and, thus, seem to be passively duplicating men's decisions.

We use data obtained from FundedByMe, the primary crowdfunding platform in Sweden. FundedByMe is an online crowdfunding platform that started in 2011. One year later, they added equity crowdfunding to their set of operations, and since then, it has launched 40 successful equity campaigns. Our sample consists of 2537 investments by 1979 unique investors between 2012 and March 2015.¹

The paper is organized as follows. The next section discusses the theoretical literature on gender-related differences in risk aversion and the herding behavior of investors. Thereafter, we present the research setting, data, and analysis. Finally, we present the study's conclusions and discuss our findings and the limitations of this research.

¹ In the Electronic Supplementary Appendix, we provide a detailed description of the FundedByMe platform and compare it with other current platforms that were the subject of several research papers.

2 Literature review

In this section, we develop two set of literature reviews regarding the underlying gender-related drivers of behaviors with a particular focus on investment decisions. We first give a general outline of gender differences as pertains to the overarching theme of behavioral attitudes towards risk perception. This perspective is among the widely popular streams of literature in economics and psychology that explain the determinants of gender-related investment outcomes. Thereafter, we discuss risks involved in equity crowdfunding and risk-related gender differences in equity crowdfunding. The second set of our literature review address differences in herding behavior based on gender. We not only highlight why herding is an appropriate lens to study the sequential investment decisions of crowdfunding participants but also propose how gender serves as salient information and helps unpack the decision-making process of individual investors.

2.1 Gender differences in risk taking for investing

The literature in the psychology and behavioral economics has widely investigated gender-based behavioral differences (Eckel and Grossman 2002; Byrnes et al. 1999). In a recent review of this literature on gender differences, Croson and Gneezy (2009) highlight that gender attitudes towards risk are a defining feature of investment decisions.² The evidence has accumulated from diverse contexts, as this stream views context to be an important boundary condition, mirroring the idea that risk might be conceptually defined and perceived differently in each context. Below, we follow suit and enumerate some of these contexts and definitions of what constitutes risks in each context to further explain why our exploration of the equity crowdfunding context could provide complementary evidence.

The first group of studies investigates gender-based risk preferences in experimental settings. The experimental studies use probability lotteries and suggest that women are more risk averse than men (Eckel and Grossman 2008; Holt and Laury 2002; Byrnes et al. 1999). The second set of evidence comes from empirical

studies. These studies mostly focus on asset allocation of personal wealth and report mostly similar results to experimental findings (Sunden and Surette 1998). Allocation between stocks and bonds is usually viewed to reflect risk preferences in this context; thus, a larger contribution of pension assets in stocks shows a greater risk-taking attitude, while investment in bonds shows risk aversion (Jianakoplos and Bernasek 1998). A third stream of literature studies the context of corporate policies and how they are linked to the gender of the firm's decision maker(s) such as executives. Whereas these studies tend to suggest mixed results regarding female-led firms and association with risky financial decisions, their departing hypotheses highlight the risk aversion of females compared to male executives or managers. For instance, Faccio et al. (2014), in a large sample of European firms, find that the transition from male to female CEOs is associated with significant reduction in corporate risk taking. In this setting, corporate risk taking is measured by leverage and earnings volatility.

2.2 Risk in equity crowdfunding

Entrepreneurial financing literature recognizes that erroneous valuation of investment opportunities is often tied to issues caused by the information asymmetry (and moral hazard) faced by prospective investors. These issues stem from the limited track record of firms in allowing investors to make informed judgments. Furthermore, absent direct and observable information (such as sales) during the early stages of firm development, valuations tend to be based on growth expectations or entrepreneurial vision, which are in turn often influenced by the natural incentives of entrepreneurs or their optimism to exaggerate their prospects (Cooper et al. 1988; Busenitz and Barney 1997). Overall, information asymmetries prevalent in equity investments of young firms exacerbate adverse selection risk for investors.

Equity crowdfunding characterizes risk capital, especially that aforementioned information problems are more severe for small investors representative of equity crowdfunding investors (Ahlers et al. 2015). Unlike professional investors, small investors are less likely to possess financial expertise or adequate time to perform due diligence (Schwienbacher and Larralde 2012). In addition to limited expertise, small investors might have limited incentives owing to their lower

² In this section, we do not explain the underlying explanatory mechanisms in attitude differences towards risk among men and women (for a discussion of possible social and biological differences, see Croson and Gneezy (2009) and Sapienza et al. (2009). Such mechanisms are tangential to our core arguments, albeit interesting.

financial stake in order to evaluate investment opportunities. These factors highlight the risks involved in equity investing for small investors. Therefore, given the role played by gender in risk-taking behavior, we expect that female investors, compared to their male counterparts, are less likely to invest in risky firms in the equity crowdfunding.

2.3 Herding in crowdfunding

There is strong and growing support in favor of herding, which claims that a higher number of early contributors increase the likelihood of success for crowdfunding campaigns, with evidence from different crowdfunding types such as donation based (Burtch et al. 2013), reward based (Colombo et al. 2015), lending-based (Zhang and Liu 2012), and equity based (Vismara 2016b; Hornuf and Schwienbacher 2015b). The premise behind herding logic is the following. It is unlikely that investors or individuals arrive at their decisions independently from others; rather, they update their expectations in a social process by observing others (Bandura 1977). Herding behavior is said to be more frequently observed when there is outcome uncertainty and sequentiality in information production. Both of these conditions appear to be strongly present in the equity crowd-funding context (Vismara 2016b; Hornuf and Schwienbacher 2015b).

We argued previously that there are often uncertainties of valuation combined with lack of expertise in the evaluation of new firms by small investors. Investors are likely to take into account others' decisions given this level of uncertainty, which is compounded by a lack of incentives to exert resources to perform due diligence. This might lead small investors to perhaps discount some of the tangible information about the firm that could have been otherwise obtained by careful screening of the information about the firm (presented in the campaign). To save cognitive effort and resources from time-consuming or difficult-to-process information such as future financial projections, equity investors might rely on cues of herding by observing others' decisions. With regard to sequentiality, equity crowdfunding websites currently show updated reports containing information such as the funded amount, number of prior investors, and the public profile of prior investors. Additionally, platforms (e.g., FundedByMe) sometimes allow sorting of projects based on the funding amount

received, which might encourage herding through easier discovery of well-funded campaigns.

Studies that have focused on herding dynamics of crowdfunders provide more sophisticated insight by inquiring about (a) the type of information obtained from observational learning and (b) whether herding is rational or irrational. Herders might not only take into account the percent funded or the number of previous contributors; they also might attend to important cues such as who the backers/investors are. Vismara (2016b) finds that the public profile of funders contains salient information regarding the identity of investors and their history of investment activity, all of which can help generate early momentum that is correlated with equity campaign success.

As regards rationality, irrational herding is said to occur when individuals passively follow others' choices (Croson and Shang 2008; Simonsohn and Ariely 2008), in which case observational learning does not occur (Banerjee 1992; Bikhchandani et al. 1992). If backers are simply replicating others' backing decisions, they will be irresponsive to how others have arrived at such funding decisions and ignore the characteristics of the project/firm/listing presented in campaign. For instance, Simonsohn and Ariely (2008) find that inexperienced eBay bidders herd into auctions with more bids yet ignore the fact that the swarm of bids results from low starting prices. If investors are observational learners, their inferences from observing others' funding decisions should be moderated by publicly observed attributes such as the quality certificates of the project. To illustrate this point, Zhang and Liu (2012) find that lenders engage in active observational learning (also here referred to as rational herding) and infer the creditworthiness of borrowers by observing other lenders' decisions such that herding is amplified (dampened) when borrowers have poor credit grades (favorable borrower characteristics).

2.4 Gender differences of herding in crowdfunding

As two instances of the two dimensions discussed in the previous section, we investigate whether (a) the proportion of prior investors of a given gender is viewed as information relevant to herding and (b) if this "gender-related" herding is rational or not (in the sense of Zhang and Liu (2012)). One might argue that women are more likely to follow women in their decision making due to the circulation of investment information in common

social networks shared by other women. Traditional investors of venture capital firms significantly underrepresent women (Greene et al. 2001; Harrison and Mason 2007; Coleman and Robb 2009), which might lead to barriers in the exchange of information regarding investment opportunities for women investors not sharing the same social ties; in other words, male investors are viewed as the gatekeepers of investment opportunities, and this process is re-enforced by the reliance of male investors on male networks for information and due diligence regarding investments. There are, however, two reasons to question this logic in our particular setting.

First, there are a number of things that could work against the possible tendency of women to follow other women in equity crowdfunding. Equity crowdfunding, at least to a certain extent, removes the aforementioned social barriers by reducing search constraints previously facing female professional investors because of the open and “democratic” setup of equity crowdfunding. The equity crowdfunding platform lists all the projects on the Internet in an open call (Ahlers et al. 2015; Hornuf and Schwienbacher 2015a), broadcasting a similar set of information with the aim of attracting as broad audience as possible. These features of equity crowdfunding might downsize the importance of the network, which is used to restrict the flow of information about investment opportunities to female investors.

Second, prior research indicates that individuals’ behavior might be influenced by implicit and unintended biases, such as the portrayal of women as less competent than men, stemming from long-term exposure to cultural stereotypes (Devine 1989; Eagly and Mladinic 1994). Women might feel there are implicit biases against their levels of competence, especially in male-dominated categories/industries (Ridgeway 2009). As such, if we assume that women share the same stereotypical views, it is unlikely that women follow other women in this investment setting. Related evidence from audit and experimental studies suggests that women in male-dominated fields (and other minorities in similar positions) might behave with a gender-induced bias and favor members of dominant groups at similar rates to those of the dominant group (e.g., Moss-Racusin et al. 2012; Nosek et al. 2002; Milkman et al. 2015). Together, all of these arguments support the idea that women are likely to pay more attention to the overall proportion of prior male investors, who are viewed stereotypically as more competent in equity investments, an area which

is further male dominated. Therefore, we expect that there is a negative relationship between the number of female investors in a given day of a firm’s listing and the overall proportion of prior female investors.

After highlighting the prominence of gender in the previous paragraphs as information relevant to female investors’ decision-making, we turn our attention to the rationality of herding based on an analytical model developed by Zhang and Liu (2012). As much as female investors assign herding momentum to favorable project characteristics such as certificates of quality, the effect of herding should be dampened. This pattern is likely to indicate that female investors are rationally observing the underlying reason for herding momentum and that their decisions are the result of observational learning (Banerjee 1992; Bikhchandani et al. 1992). Conversely, if the effect of herding is amplified (dampened) in the presence (absence) of favorable project characteristics, then female investors are simply duplicating men’s decisions without rationally observing what drives their decisions. In this case, female investors follow descriptive social norms or simply well-funded and salient firms listed on the platform (Simonsohn and Ariely 2008; Croson and Shang 2008).

To disentangle mere conformity from rational observational learning, we look at how female investors react to information on external certificates (e.g., receipt of seed investment). To illustrate, suppose two firms with an equal proportion of male investors at a given time, t . One firm has external certificates, and the other has no external certificates. From the perspective of female investors, male investors must have sufficiently positive private information or the competence to evaluate better an investment proposal willing to fund a firm that is not certified. However, the decision to invest in a certified firm is easy to justify and does not necessarily imply favorable private information on the part of prior male investors. Therefore, it should follow that incremental quality inference about the not-certified firm is higher for the subsequent female investor given the same proportion of male investors at a given time, t . In this sense, rational observational learning implies that male-based herding momentum will be dampened by favorable firm characteristics. Therefore, we empirically test whether the negative relationship between the number of female investors in a given day of a firm’s listing and the overall proportion of prior female investors strengthens (or weakens) with external certificates.

3 Methods

3.1 Sample

We collected data from FundedByMe, the largest crowdfunding platform in Sweden (Ingram and Teigland, 2013).³ Our sample includes all investors in 31 campaigns,⁴ which include successful equity crowdfunding campaigns posted on FundedByMe from the start of equity crowdfunding by FundedByMe in 2012 to the end of March 2015. We collected firm information about the campaign from the FundedByMe website. We were able to extract the name of investors and the time of investment from the activity log of campaigns. We excluded investments made from team members who enjoy private information (we know their names from the campaign) to keep a consistent sample in line with our focal investigation. The final sample includes 2537 investments by 1979 unique investors.

We took several steps to code genders based on first names. We first algorithmically used the API of genderize.io (a similar procedure used in Greenberg and Mollick 2014) by providing several country and language inputs such as Swedish, German, and Finnish. The algorithm returns the gender and a probability that a specific name-gender attribution (male or female) was correct; in the case it cannot decide, the algorithm returns none. In a second step, one of the authors speaking the Swedish language double-checked the accuracy of the codes and completed the missing variables, with additional help from the profile picture of the users, LinkedIn and Google Search (mostly in ambiguous cases such as unisex names). Most of the investors used their real name instead of pseudonyms as FundedByMe encourages this practice (in our sample, only approximately 3% of investors used pseudonyms).

3.2 Analysis of gender-related risk taking

Dependent variables There are several observed characteristics of firms that we hypothesize to show the risk

profile of future cash flows. First, younger firms are riskier because nascent firms suffer from liabilities of newness and smallness (Stinchcombe 1965). They have short track records and have had less time to accumulate tangible resources, which increases the risk of investment. *Firm age* is the numbers of years since the firm's establishment. On average, investors invest in firms that are 2.6 years old.

Second, the technology category is another proxy for risk. Technology firms are involved in developing and commercializing innovative projects with a high uncertainty in outcome (Hall and Lerner 2012). *Technology firm* is a dummy variable denoting 1 for firms operating in the technology category such as mobile apps. Technology firms comprise 60% of investments and 58% of the total firms.

The third variable of risk is the *Equity offering (%)* of the campaign. Leland and Pyle (1977) suggest how firms opportunistically choose to raise equity when managers know that their shares are overvalued, and investors perceive equity offerings as a negative signal, taking this former information into consideration. Likewise, an owner's decision to offer a lower amount of equity can indicate less adverse selection risk in that a bad outcome is less likely to be perceived by owners (Ahlers et al. 2015). Furthermore, greater equity offerings can dilute entrepreneurs' incentive to commit to their firms. Altogether, more *Equity offering* suggests that a firm is riskier. On average, investments are in firms that offer 12.5% of their equity.

Independent variable Female is a dummy variable equal to one for female investors and zero for male investors. Female investors commit about 20% of investments.

Control variables Several variables might influence the investment decisions of investors. We control for the number of prior investors (*No. prior investors*) and the frequency of investments in prior days (*Investment rate*). Number of prior investors is on average 85 (with a maximum of 365 investors). Investment frequency is calculated as the number of prior investors divided by days that have passed since the start of the campaign. These values show the traction of a campaign and how successful it has been so far. The campaigns receive on average 0.8 investments per day (with a maximum of 5.5). The percentage of days passed (*Share of days passed*) presents the number of days passed since the

³ In the supplementary online appendix, we explain FundedByMe features with detail. We also compare FundedByMe with other equity crowdfunding platforms.

⁴ There are 40 successful equity crowd-funding campaigns posted on FundedByMe; however, we were not able to access the activity log and investor names for 9 of these campaigns. We communicated this issue to the helpful team of FundedByMe, and they also pointed to a transfer from a legacy database as a reason for not showing those investments.

launch of the campaign over its planned duration. The passage of time can provide more information, such as the percentage of funding and a forward-looking estimation on whether the campaign will reach its funding goal. The investment takes place on average after 37.5% of the campaign duration has passed. There are also time-invariant control variables. We group a number of variables that (a) are correlated positively with the unobservable direct quality of the firm and (b) are difficult and costlier for a low-quality type of firm to imitate compared to a high-quality firm. *External certificate* is a dummy variable and takes value one if a firm has filed for patent, received governmental seed investment, or introduced a lead investor (VC or angel); otherwise, it is zero. Patent shows the capability of R&D staff and technical capabilities of the firm and is viewed as a valuable positive signal decreasing information asymmetry for investors (Hsu and Ziedonis 2013). Affiliation with prestigious external stakeholders (e.g., reputable VCs) increases the legitimacy of the new firm, as new firms can borrow the reputation and legitimacy of those firms (Stuart et al. 1999). On average, 52.7% of investments are in firms with external certificates. Furthermore, we include the natural logarithm of valuation in Swedish Krona (SEK). The valuation of firms varies between 2.1 and 69.9 million SEK, with a mean value of 26.9 million SEK.⁵ Given that entrepreneurs have a richer endowment of social capital from their home country (Dahl and Sorenson 2012), we control for location, which is set to one if the firm is located in Sweden and otherwise is set to zero. As female investors might be more likely to invest in projects with a higher share of female team members, we insert a dummy *Woman on Team* that is set to one if there is at least one female member on the project team and otherwise is set to zero. Finally, first-time investors on the platform might be systematically different from investors with a prior history of investment using this platform in that these investors might include friends and family. Therefore, *Investment experience* takes a value of one for investors with a prior history of funding a firm on the platform and otherwise is zero for first-time investors. Investments made by repeated investors comprise 13% of investments. To capture possible temporal trends, we insert week-day (6 dummies) and year fixed-effect (2 dummies) in all models.

⁵ From 2013 to 2015, the average of the exchange rate was equal to 7.1 USD/SEK.

Model specification We use ordinary least square (OLS) regression when dependent variable is *Firm age* and *Equity offering* and we employ logit regression when dependent variable is *Technology firm*. Specifically, we use the following specification:

$$Y = \beta_0 + \beta_1 \text{Female} + \alpha \text{Controls} + \varepsilon \quad (1)$$

Y defines separately the following risk proxies: *Firm age*, *Technology firm*, and *Equity offering*. The standard errors are robust and clustered around investors to control for non-independence of observations for investors across firms.

Analysis Table 1 reports the descriptive statistics of variables in addition to correlation matrix, and Table 2 presents the results of regressions models.

We perform formal tests of variance inflated factor (VIF) and conditional index (Belsley et al. 1980), and these tests do not suggest severe issues of multicollinearity.

Model I presents the estimates of OLS model predicting *Firm age*. The coefficient of *Female* is positive and statistically significant ($p < 0.01$), suggesting that female investors are more likely to invest in older firms. In terms of magnitude, female investors, compared with male investors, are associated with firms that are on average less than one year older (0.76). Model II presents the coefficients of logit regression predicting *Technology firm*. Female investors are 35.7% less likely to invest in firms categorized as technology intensive ($p < 0.01$). Finally, model III shows estimates of the OLS model predicting *Equity offering*. Female investors are less likely to invest in firms with higher equity offering ($p < 0.05$). The coefficient implies that female investors, compared with male investors, are associated with firms that on average offer −0.48% less equity. Altogether, these results provide supporting evidence in favor of H1.

We also employ Tobit specification on model I and model III because the dependent variables are non-negative. The results remain unchanged.

3.3 Herding and gender in equity crowdfunding

Dependent variable *Number of female (male) investors* in each day is the count of the current incremental number of female (male) investors. These variables are logged.

Table 1 Summary statistics and pairwise correlation ($N = 2537$)

	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1. Firm age	2.64	2.64	–										
2. Technology firm	0.61	0.49	–0.53	–									
3. Equity offering (%)	12.56	7.35	0.38	–0.10	–								
4. Female	0.20	0.40	0.14	–0.13	0.01	–							
5. No. prior investors	3.91	1.22	0.27	–0.08	0.21	0.02	–						
6. Investment rate	0.79	1.22	0.19	–0.07	0.15	–0.03	0.24	–					
7. Share of days passed	0.37	0.35	–0.19	–0.05	–0.10	0.03	0.21	–0.42	–				
8. External certificate	0.53	0.50	0.30	0.24	0.06	0.00	0.17	0.14	–0.29	–			
9. Woman on team	0.58	0.49	0.37	–0.03	0.50	0.05	0.10	0.14	–0.19	0.32	–		
10. Valuation ^a	16.73	0.94	0.20	–0.23	–0.31	–0.03	0.38	0.36	–0.31	0.24	–0.21	–	
11. Sweden	0.64	0.48	0.44	–0.45	0.46	0.02	0.32	0.31	–0.20	–0.05	0.43	0.30	–
12. Investment experience	0.13	0.34	–0.06	–0.03	0.04	–0.18	–0.17	–0.02	–0.05	–0.06	0.00	–0.07	0.00

^a This variable is logged

Independent variable *Female share of prior investors* is the proportion of investors who are female to the total count of all investors until the previous day of the campaign.

Control variables We include time-varying control variables such as *No. of prior investors* and *Frequency of prior investors*. The number of prior investors is the total count of prior investors until the previous day, and the *Frequency of prior investors* represents the total number of prior investors divided by the number of days that have passed until the previous day. We also included week-day fixed effects. Table 3 reports descriptive statistics, including the mean and standard deviation in addition to the correlation of variables.

Model specification We identify herding using the following specification. y_{jt} represents the incremental number of female investors at each day t investing in firm j (for brevity of argument, we focus only on female investors as a dependent variable in the following description). Let $Y_{j,t-1}$ be the lagged total proportion of female investors and X_{jt} be other observable time-varying attributes related to the funding progress of firm j .

$$y_{jt} = \alpha Y_{j,t-1} + \beta_1 X_{jt} + \beta_2 Z_j + u_j + v_{jt} \quad (2)$$

It is unlikely that we will capture every source of heterogeneity across firms given our available data. For instance, firms could have products that appeal to

female investors, such as fashionable women's clothes, which might attract female investors, yet our data does not include a variable denoting the product-category variable. Therefore, the unobserved firm attributes represented as u_j could consist of, for instance, fashionable clothes for women. As a result, u_j might be correlated with both the proportion of female investors (i.e., $Y_{j,t-1}$) and the current incremental female investors attracted (i.e., y_{jt}). This would cause endogeneity problems in estimating the effect of $Y_{j,t-1}$ on y_{jt} (i.e., coefficient of α in the Eq. 2). Therefore, we need to control for unobserved firm heterogeneity with firm-fixed effects to capture the unobserved correlation of preferences among female investors facing the same firm. We assume that u_j is time invariant because firm attributes are unlikely to radically vary from the launch of the campaign to the end of the campaign. Given the strict multicollinearity between observable time-invariant firm attributes Z_j with unobserved firm-fixed effect u_j , the effect of Z_j cannot be separately estimated. We argued that given website design features of FundedByMe, such as featuring the well-funded firms and the inclusion of these firms in the newsletter emails subscribed by investors, it is likely that well-funded firms become salient to subsequent investors and give rise to irrational herding. By drawing on cross-sectional variation in the publicly observable firm attributes, we can distinguish whether investors are replicating others' decisions and ignore how others have arrived at such decisions. Consistent with Zhang and Liu's (2012)

Table 2 Regression analysis

	Model I Firm age	Model II Technology firm	Model III Equity offering (%)
Female	0.760*** (0.116)	-1.032*** (0.126)	-0.480** (0.244)
No. prior investors	0.137** (0.054)	0.439*** (0.058)	1.642*** (0.118)
Investment rate	-0.030 (0.048)	0.074 (0.051)	0.176*** (0.066)
Share of days passed	-0.222 (0.171)	-1.553*** (0.193)	-3.854*** (0.390)
External certificate	1.297*** (0.103)	0.643*** (0.121)	3.459*** (0.257)
Woman on team	0.527*** (0.071)	-0.173 (0.150)	-0.756** (0.332)
Valuation ^a	-0.002 (0.056)	-1.013*** (0.071)	-5.440*** (0.177)
Sweden	2.215*** (0.117)	-2.642*** (0.194)	8.280*** (0.390)
Investment experience	-0.122 (0.118)	-0.207 (0.157)	0.033 (0.287)
Constant	-1.535* (0.809)	17.891*** (1.179)	82.749*** (2.606)
Year fixed effect	Yes	Yes	Yes
Week-day fixed effect	Yes	Yes	Yes
N	2537	2537	2537
Specification	OLS	Logit	OLS
R-squared	0.343	—	0.640
Pseudo-R-squared	—	0.314	—

In all models, robust standard errors are reported in parentheses
*, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively

^a This variable is logged

operationalization of this idea, we include the interaction term between lagged proportion of female investors and publicly observable firm attributes (Z_j) such as *External certificate*.

$$y_{jt} = \alpha Y_{j,t-1} + \beta_1 X_{jt} + \beta_2 Z_j + \beta_3 Y_{j,t-1} Z_j + u_j + v_{jt} \quad (3)$$

As a result of rational observational learning, a subsequent female investor would make more positive incremental quality inference after observing the momentum associated with higher-proportion of male investors (i.e., male-based herding momentum) about a firm without external certificate. We expect the male-based herding momentum will be accentuated by unfavorable firm characteristics and dampened by favorable firm characteristics in case of rational herding. Thus, the moderating effect of male-based herding on *External certificate* is relevant in determining whether female investors are rational observational learners or not. As such, in Eq. 3, if β_3 has the same (opposite) sign as external certificate effect (i.e., positive) for subsequent female investors, subsequent female investors are irrational observational learners of proportion of male (female) investors.

Analysis We present descriptive statistics in Table 3 and the results from fixed-effect regression analysis in Table 4. Models I and II are models with the dependent variable set to the number of female investors, and models III and IV are related to the number of male investors as dependent variables.

There are two noteworthy results in models I and II, which predict the number of female investors in a given day. First, the coefficient of *Female share of prior investors* is negative ($p < 0.1$) in model I. Second, the

Table 3 Summary statistics and pairwise correlation ($N = 1639$)

	Mean	S.D.	(1)	(2)	(3)	(4)	(5)
1. No. female investors ^a	0.165	0.429	—				
2. No. male investors ^a	0.477	0.695	0.54	—			
3. No. prior investors ^a	3.628	1.311	0.05	-0.01	—		
4. Frequency of prior investors	2.861	5.705	0.28	0.34	0.44	—	
5. Share of female prior investors	0.162	0.155	0.26	0.03	0.25	0.07	—
6. External certificate	0.485	0.500	-0.01	-0.03	0.23	0.18	-0.02

^a This variable is logged

interaction term between share of *Female share of prior investors* and *External certificate* is negative ($p < 0.01$) in model II (in this model, *External certificate* is dropped due to the strict collinearity with project fixed effects). Combined, these results suggest that women are less (more) likely to follow women (men) and that this effect is stronger when there is an external certificate of the project. The amplified effect of gender-related herding in the presence of favorable characteristics indicate the women are not assigning gender-related herding momentum to the quality of the project and are thus ignoring the reasons behind male investors' decisions.

We perform the same set of analyses in models III and IV, which predict the number of male investors in a given day. The coefficient of *Share of prior female investors* is positive but not significant at conventional significance levels. In model IV, we also do not find a moderating effect of *External certificate* for *Share of female prior investors*. Overall, these results suggest differing patterns of gender-related herding for male investors compared with female investors.

4 Discussion and conclusions

By observing gender-induced patterns of investments from one equity crowd-funding platform located in Sweden, we present evidence regarding risk-averse attitudes in female investors. Furthermore, the results regarding gender-related herding are novel in that we shed light on the various processes of decision-making for female investors compared with male investors. Our results suggest that women are perhaps biased in their view of the competence of other women in equity investing, interestingly resulting in duplicating men's decisions.

Our paper has several contributions and limitations. First, this study contributes to the literature explicating the role of gender in investment behavior and, more specifically, explores gender differences in herding. Although Sweden ranks persistently high in the list of gender equalitarian countries in the world,⁶ cultural stereotypes might still persist. We believe there is room to educate investors, who happen to suffer from under-representation in managerial positions in firms and in male-dominated fields/industries such as angel

investing or venture capitalists, against competence-bias. Furthermore, we complement studies that offer insight into the role of risk aversion based on gender and link these perceptions to investment outcomes. Particularly, this is the first time that the setting of equity investments is used to show how several hypothesized parameters of risk combine to inform the decisions of female investors in the equity-crowdfunding platform. Finally, we contribute to the nascent literature on crowdfunding (Belleflamme et al. 2014; Mollick 2014; Colombo et al. 2015; Agrawal et al. 2015; Ahlers et al. 2015; Hornuf and Schwienbacher 2015a). By investigating the gender-related patterns of investment behaviors, we suggest how gender-based risk-preferences play a role.

Our study has several limitations that open up avenues for future research. First, our study is limited in that the observed variables chosen might possibly capture other dimensions relevant to female decision making unrelated to risk (e.g., disposable income), or even unobservable preferences, such as the desire to support socially beneficial products or services by women investors (Harrison and Mason 2007). We agree with this shortcoming, which is one of the problems of research designs that look at aggregated real-life investment decisions commonly present in prior research. It is therefore helpful to complement our study with field experiments mimicking crowdfunding settings that allow for better identification strategies. Despite this methodological issue, we contend in support of our risk-aversion conviction that (a) equity investment inherently characterizes a decision with a high component of risk and that (b) the role of risk perception is obviously stronger and salient for equity crowdfunding participants with potentially limited expertise and resources to evaluate the quality of firms, at least compared to prior empirical settings in asset allocation in bonds and stocks or lotteries with low-sized stakes. We used several proxies of risk in this context, and the results are all statistically significant; thus, we cannot argue that our proxies combined are on average always unrelated to risk preferences, and we are only observing spurious correlations.

Second, the limitations of our study are related to the generalization of results based on a single platform located in one country. First, future replication studies across countries and platforms are encouraged to understand whether certain institutional contexts of the

⁶ <http://reports.weforum.org/global-gender-gap-report-2014/>

Table 4 Firm fixed-effect panel data regression

	Model I No. female investors ^a	Model II	Model III No. male investors ^a	Model IV
No. prior investors ^a	-0.084*** (0.014)	-0.082*** (0.014)	-0.256*** (0.022)	-0.255*** (0.022)
Frequency of prior investors	0.018*** (0.002)	0.018*** (0.002)	0.045*** (0.003)	0.045*** (0.003)
Share of prior female investors	-0.279* (0.161)	0.002 (0.188)	0.405 (0.256)	0.467 (0.300)
External certificate ^b × share of prior female investors		-0.881*** (0.308)		-0.192 (0.491)
Constant	0.433*** (0.052)	0.447*** (0.052)	1.107*** (0.082)	1.110*** (0.082)
Firm fixed effect	Yes	Yes	Yes	Yes
Week-day fixed effect	Yes	Yes	Yes	Yes
<i>N</i>	1639	1639	1639	1639
<i>P</i> value of joint <i>F</i> -test	0.000	0.000	0.000	0.000

In all models, robust standard errors are reported in parentheses

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively

^a This variable is logged

^b Given the strict multicollinearity between external certificate with firm-fixed effects, the effect of external certificate cannot be separately estimated

platform or the country of investors present in our study influence the findings of the study. For instance, currently, FundedByMe allows all individuals to invest as opposed to certain accredited and wealthy individuals. Furthermore, Sweden is a country in which the political and legal systems encourage gender equality (World Economic Forum, 2014); further research in other countries should yield interesting insights and highlight which institutional factors combine to inform the investment decisions of female investors. Given the nascent state of equity crowdfunding, there seems to be a large heterogeneity among the functioning of the platforms (i.e., business models) influenced by the legal protection of investor rights in each country. Therefore, caution should be taken about the generalizability of our results across location and time.

Our research also has managerial implications. For platform creators, we suggest that platforms facilitate the presentation and digestion of information to investors; for instance, platforms could hire independent third-party professional investors such as angel investors to declare their opinion about valuation of the company, risk factors, and so on. This information

might reduce decision bias and attract more female investors.

Future research can benefit from applying other theories of judgment and decision making to offer insights to the domain of equity-based crowdfunding. Acknowledging that decision makers are bounded by rationality (i.e., plagued by various decision-making biases) and that decisions are typically made based on limited and incomplete information that is further compounded by uncertainty (Dunham 2010; Simon 1979), individuals might use heuristics for judgment. Though heuristics are shortcuts that expedite decision-making and save cognitive resources, they are often inaccurate (Tversky and Kahneman 1973). We know little about what cognitive shortcuts or rules equity crowdfunding investors will employ in their search of investment opportunities in addition to herding (Wood and Williams 2014). Along with our understanding of decision making from the study of venture capitalists' decision-making (Zacharakis and Meyer 2000), it is interesting to explore questions such as whether participants of crowdfunding show overconfidence and, if so, how this is linked to gender.

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